Title: Go Fly a Kite!

Brief Overview:

Students will learn the history of kites using various sources (reading materials and Internet) as determined by the teacher. Students will work in groups of two to four. They will use dot paper / grid paper to create drawings of a diamond, hexagonal, and shield shaped kite that will each have the same area.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*

- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*

- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*

- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

<u>Number and Operations</u>

Students will demonstrate their ability to use customary units when designing their kites. Students will apply proportional conversions to create a scale drawing of their kite.

<u>Algebra</u>

Students will be able to use mathematical models to represent and understand quantitative relationships between area and perimeter of geometric shapes. Students will identify the pattern, relation, or function (equation) relating area and perimeter.

Geometry

Students will be able to calculate the area and perimeter of polygons. Students will demonstrate their understanding of spatial reasoning to construct scale drawings of different kite designs.

Measurement

Students will be able to use customary units to determine the area and perimeter of different kite designs.

Data Analysis and Probability

Students will be able to determine the height that each kite flies by various means and record the data. They will use visual observation, Pythagorean Theorem, and trigonometric functions.

- **Process Standards**

Reasoning and Proof

Students will be able to defend their prediction of the superior kite design using the results of the class activities.

Communication

Students will present their conclusions and explanations using the language of mathematics in correct writing.

Representation

Students will be able to represent their conclusions through a variety of means: graphs, drawings, and models.

Links to National Science Education Standards:

- **Unifying Concepts and Processes**
  Students will demonstrate their ability to measure, create, and explain models.

- **Science as Inquiry**
  Students will demonstrate their understanding about scientific inquiry.

- **Science and Technology**
  Students will demonstrate their abilities and understanding of technological design, science, and technology.

Grade/Level:

Grades 6-8, all learning levels

Duration/Length:

Five (5) - 60 minutes periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Estimation
- Measuring
- Calculating area and perimeter of polygons especially triangles and rectangles
- Make scale drawings using ratios and proportions

Student Outcomes:

- Students will be able to make drawings of different kite designs each having the same area.
- Students will be able to compare how the different designs fly.
- Students will follow directions to create a kite.
- Students will find area and perimeter of polygons.
- Students will create scale drawings and construct a given kite design.
- Students will predict a design they believe superior (flies highest).
- Students will be able to analyze data, draw a conclusion, and defend it.

Materials/Resources/Printed Materials:

- Pencils
- Dot paper / grid paper
- Rulers
- Compass
- Protractors
- Chart paper (3 feet by 3 feet)
- Plastic sheet (3 feet by 3 feet)
- Dowels 1/8 inch that have lengths of 36 in.
- Household string
- Masking tape
- Duct tape
- Scissors
- Small saw or sharp knife
- Teacher’s protractor

Development/Procedures:

Day 1
Students will do an introductory activity to kite flying and construction. This may consist of a reading activity, Internet search, or video. The introduction activity will be followed by a whole class discussion. Students will form 2-4 person groups and create drawings of three kite designs (diamond, shield, and hexagon) on grid paper. They will find the area and perimeter of each shape.

Day 2
Each group will be assigned one of the three kite types. Student groups will create scale drawings (scale given by teacher) of their kite type.

Days 3 and 4
Each group will create a life size model of their kite from chart paper. The groups will construct their kites using the material provided by the teacher.

Day 5
Student groups will fly their kites. They will determine which kite design flies the highest.

Performance Assessment:

Student progress will be assessed using scoring keys for each day's activities (Day 1 & 2). A scoring rubric (holistic) will be used for Days 3 and 4 activities. Day 5 will be assessed subjectively by the teacher on general behavior during the kite flying time. Scoring sheets are included.

Extension/Follow Up:

Calculate the height actually flown by each kite type using: astrolobe, application of Pythagorean Theorem, and trigonometric functions. Explore how Bernoulli's Principle applies to kite flying. Create, build, and fly an original kite design.

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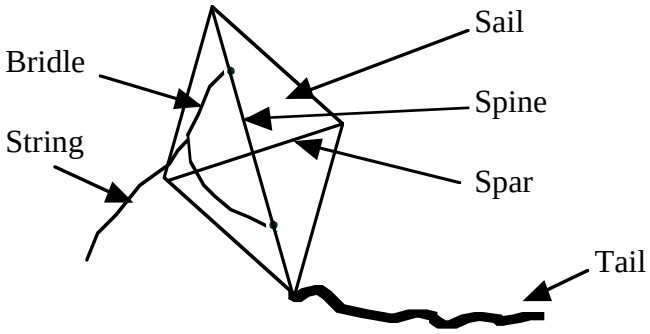
Teacher Instructions

The learning unit is purposely left open ended in some areas. This is intentional on the authors' part to let the individual teacher add or not depending upon their own comfort level in managing certain aspects of the unit.

Day 1:

The teacher should introduce the concept with the purpose of conducting a whole class discussion on kite flying. This could consist of reading a short article about kite flying (about the Smithsonian's Kite Festival for example). There are myriads of sources available on the Internet (short list of sites is at the end of this sheet). After time for the students to gather some information, the teacher should pose questions that generate some discussion about how kites fly and differences of designs. The questions may first be responded to in writing (supporting MSPAP Language Usage skills) and then have the class discussion.

Next the teacher should show pictures of the three kite designs that the students will work with and identify the parts (see figure). Explain that each student group will produce both individual work and a group project. Hand out the student instruction sheet for day 1. Read over it with the students and answer questions as needed.



KITE PARTS

DAY 1 Task: Using the provided dot/grid paper (Worksheet 1) create three kite drawings (one for each kite type) which has an area of 430-450 square inches. The provided grid paper uses a scale of each grid representing 3 inches. Have extra sheets of the gridded paper available. After they create their three drawings, students will determine the dimensions for each design (Worksheet 2). They then find the area and perimeter of each design (Worksheet 3).

The scoring key for day one may also be used for student self-assessment.

Day 2:

Assign a kite design to each group (count off by threes for example). Each student will use this design and create assorted scale drawings using the large grid paper as necessary (Worksheet 4).

Scale Drawings: **2:1** **3.5:1** **1:3**

After finishing their drawings, students will answer the questions on Worksheet 5.

The scoring key for Day 2 may be used for self-assessment.

Days 3 and 4:

Hand out the materials for creating a full-size model and actual kite (Worksheet 6). Assist students as needed. After all groups have completed their kites, provide string to each group to make the bridle. Lead the whole class in doing this step.

Making a bridle: The bridle is the line which connects the kite to the flying line. Take a piece of string about four(4) feet in length and pass it through the holes made earlier so that you have a single piece of line on the front of the kite. Tie this off at both ends to the spine at the back of the kite. With the kite facing up lying on the floor, pick the kite up with the string to find the point on the bridle that makes the front (top) end lift first and reach a height of around 5 inches from the floor before the rear (bottom) end of the kite starts to lift off the floor. This is the point on the bridle will be the towing point and at which you will make a small loop to attach your flying line.

The scoring rubric for these days should be done only by the teacher.

Day 5:

When taking students to fly their kites, go over basic safety rules.

1. Do not fly near any overhead wires or utility poles (football fields are ideal).
2. Be aware of how much line remains on your spool so that you don't watch helplessly as your kite sails away.
3. Watch where you move so as not to cross lines with other kites.
4. Follow all directions from the teacher.

HAVE FUN!!!!

Internet Addresses

History of Kites
www.geocities.com/Colosseum/4569/history.htm

Kite History
www.sound.net/~kiteguy/history2.html

History of Kites in Japan and Other Parts of the World
www.arc.unt.edu/ntieva/artcurr/japan/kites.htm

Kite Experiment
web.stclair.k12.il.us/splashd/kiteexp.htm

So You Want to Make a Kite
www.akg.cwc.net/so%20you%want%20make%20a%20kite.htm

Kite Making
www.askasia.org/frclasrm/lessplan/100036.htm

You Can Do It, Build a Kite
www.looklearnanddo.com/documents/projects_kites3.html

Teachers and Parents Kite Building Lesson
www.planemath.com/activities/flykite/kiteteachers.html

Student Instructions

Day 1

- Students will be arranged into groups of 3 or 4.
- Students will research and discuss articles about kite flying and may have access to the Internet for specified sites.
- Students will identify the parts of the kite and on dot/grid paper (Worksheet 1) and create three different shape kite drawings, specifically shield, diamond, and hexagon, with a specified area of 430-450 sq. in. whereby each block = 3 inches on a side.
- Students will determine the dimensions (Worksheet 2) and find the area and perimeter of each design (Worksheet 3).

Day 2

- Students will be assigned one design and create the specified area for the kite to build and then proceed to use ratios and proportions to create assorted scale drawings using large grid paper (Worksheets 4 and 5).
- Scales are 2:1; 3.5:1; and 1:3
- Use scoring sheet for self-assessment.

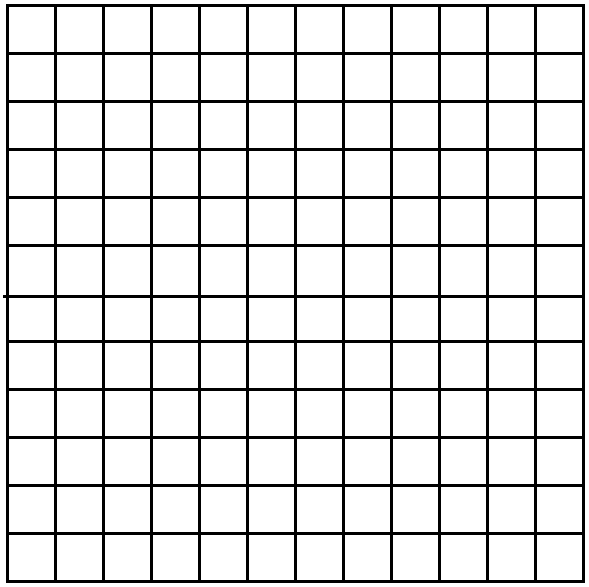
Days 3 and 4

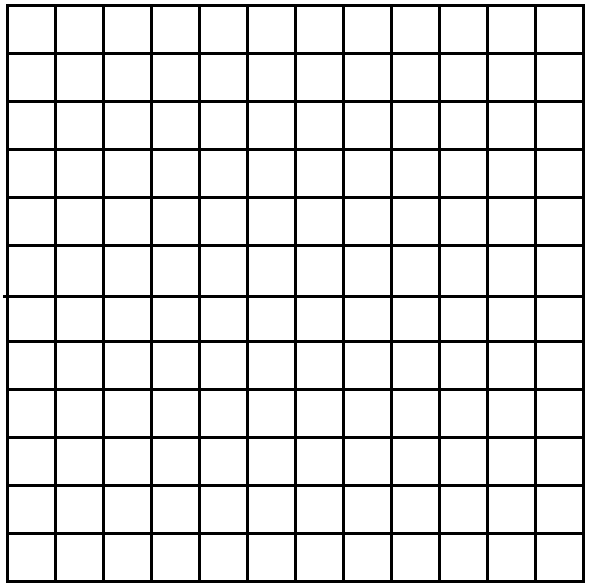
- Students will create a full size model and actual kite (Worksheet 6-Directions for Making a Kite) with the teacher to assist.

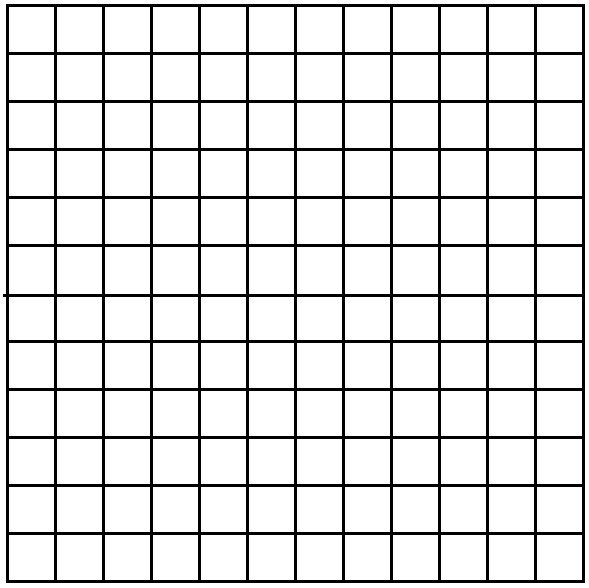
Day 5

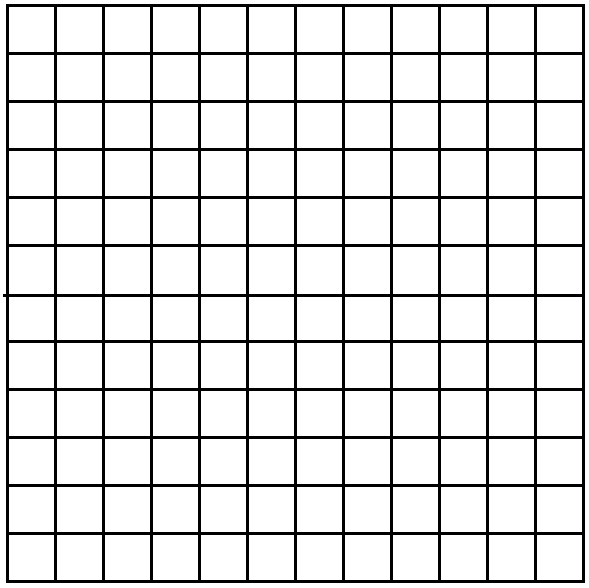
- Students will learn specific safety rules about flying kites and proceed to GO FLY A KITE!!

Worksheet 1









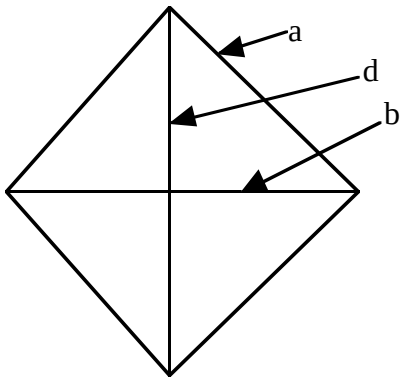
Worksheet 2

Directions: Create a drawing of the 3 shapes, diamond, hexagon, and shield, with a given area of 430 - 450 sq. in. on grid paper. Use the final drawing of each kite shape on your dot/grid paper and determine the dimensions (a, b, c, d, e) as needed to fill in the following table. Remember that each square represents 3 inches. Show the outline of all your calculations below. Label the calculations clearly for each shape.

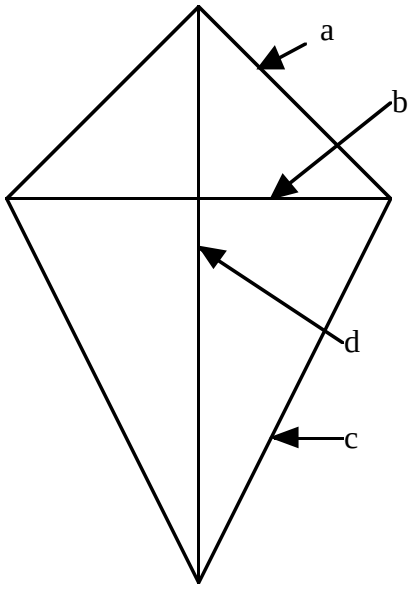
Dimension Table
(actual dimensions in inches)

Kites	a	b	c	d	e
Diamond			**N/A**		**N/A**
Shield					**N/A**
Hexagon			**N/A**		

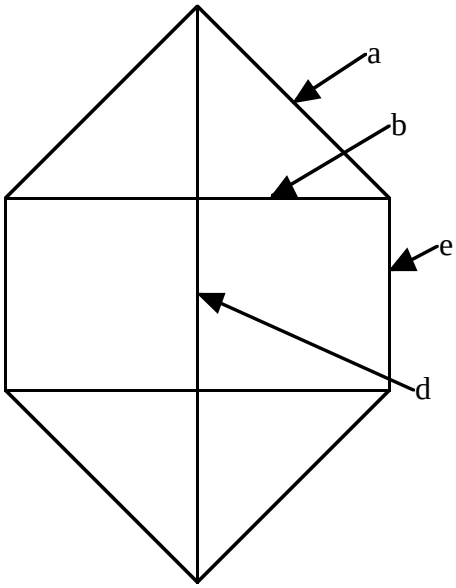
Diamond



Shield



Hexagon



Worksheet 3

Determine the area and perimeter for each shape. Show the outline of your calculations below. Label all work.

Diamond Kite

Area Perimeter

Shield Kite

Area Perimeter

Hexagon Kite

Area Perimeter

Explain how you found the area and perimeter for each shape.

_____

_____

_____

_____

_____

Explain how you found the dimensions of each kite from your table.

_____

_____

_____

_____

_____

Predict which type of kite will fly higher and why?.

_____

_____

_____

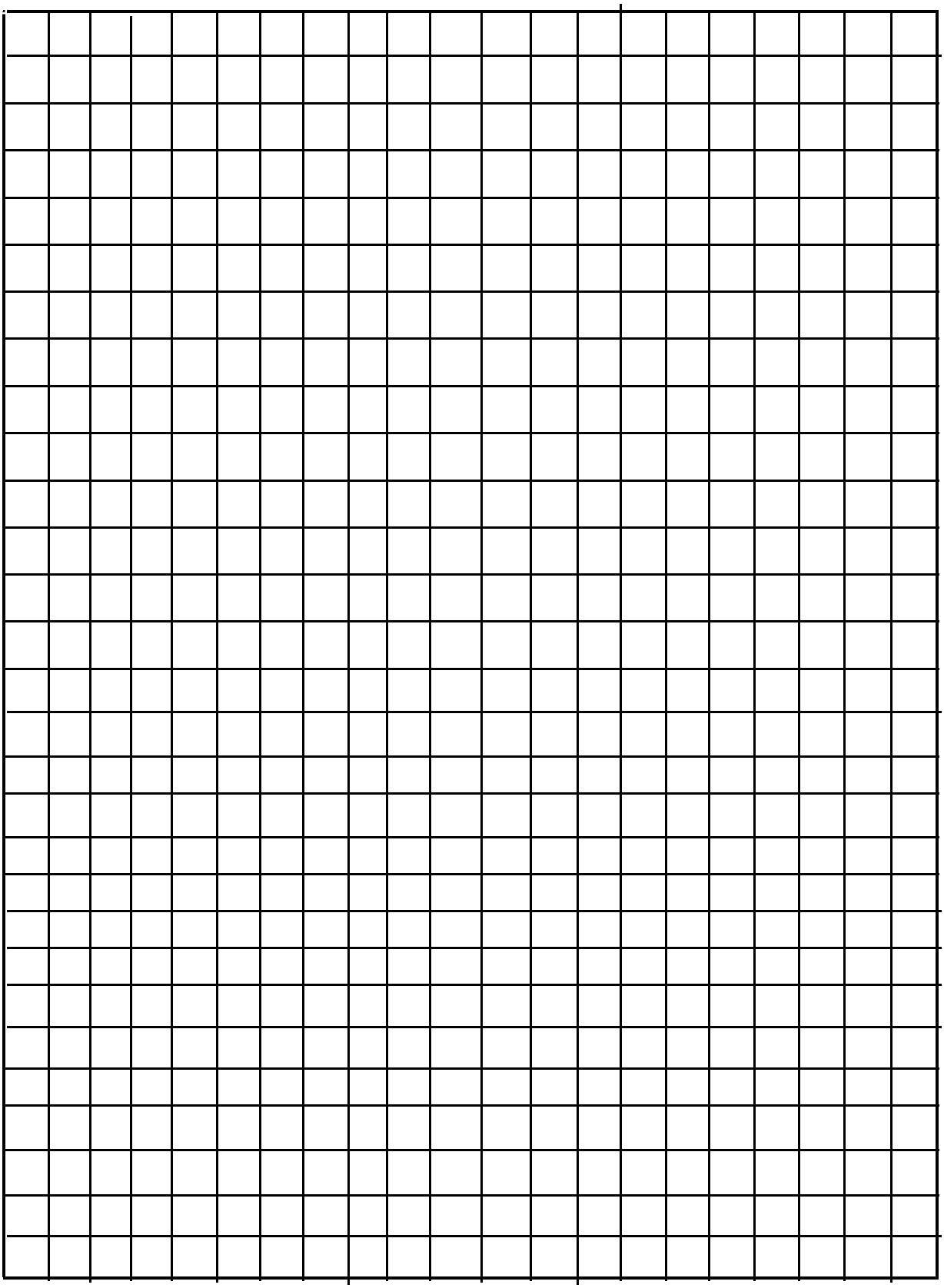
_____

_____

SCORING KEY FOR DAY 1

Areas Assessed	Points		
	15	**10**	**5**
1. Three sketches created and labeled.			
2. Table/Charts filled in.			
3. Dimensions for each shape meets the given constraint.			
4. All calculations shown and labeled.			
5. Explanation of how dimensions of kites were determined.			
6. Explanation of how area was determined.			

Worksheet 4



Worksheet 5

Explain how you found measurements for each scale given.

Explain how you transferred the new measurements to the grid paper.

SCORING KEY FOR DAY 2

Areas Assessed	Points		
	15	**10**	**5**
1. Three scale drawings created.			
2. Accurate drawings.			
3. Labels for drawing.			
4. All calculations shown.			
5. Explanation of how the different scales measurements were created.			
6. Explanation of how the measurements were put on paper.			

Worksheet 6

Directions for Making a Kite

1. Using a 3’ x 3’ sheet of paper, proceed at the top center and begin to draw your kite with the appropriate lengths calculated (include the position of the dowels).

2. Cut out the model and lay flat on the plastic sheet. Tape edges at the corners (to help hold the kite in place), trace around the model, and cut out the kite.

3. Place the straight dowel (the spine) in the center of the longest dimension and use masking tape (about 2 in) over the end of the dowel and plastic to hold the dowel in place. Then take a piece of duct tape about 1/4 in. wide and 1 1/2 in. long and twist it around covering the masking tape on the dowel. Do the same on all corners.

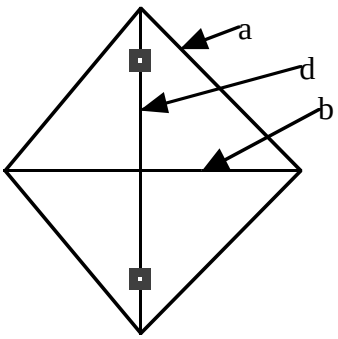
4. Repeat for the dowel(s) forming the crossing spar(s).

5. Where the dowels cross, take wire ties and twist to hold them securely. Cover the ties with some tape if desired.

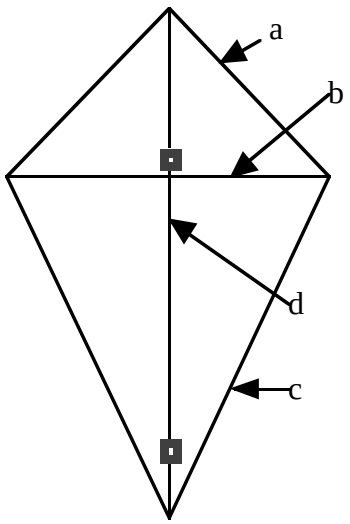
6. Place duct tape at those areas designated in the pictures below on the reverse side of the plastic and punch small holes in the plastic and tape which will be used for attaching the bridle .

7. Make a tail as needed for your kite.

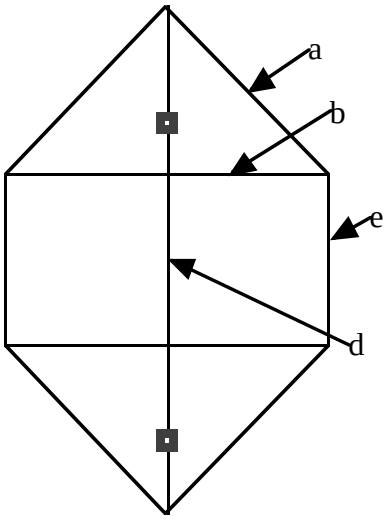
Diamond



Shield



Hexagon



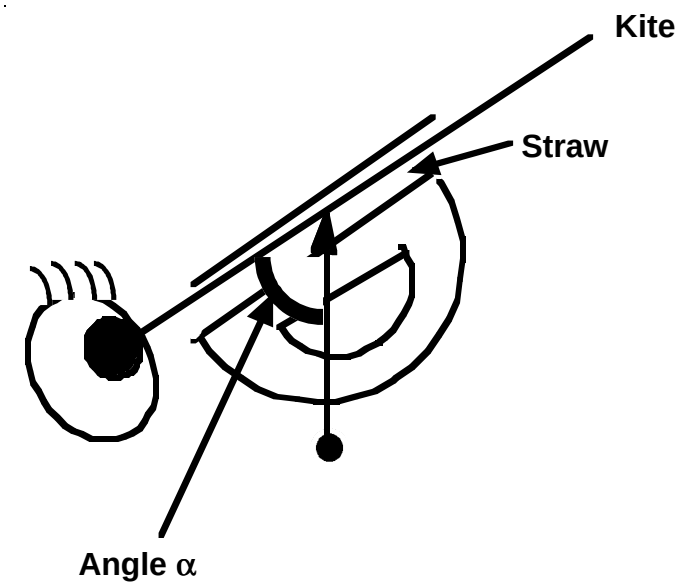
Extension/Follow Up:

1. How High is the Kite?

Students will measure how high the kites fly by using one or more of the following three methods. The different methods are tailored to meet the students' different learning levels. The first method may best be used with low level students, the second method with on grade level students, and the third method with advanced students. For all of the methods, the ball of string (approx. 40-50 yards)that is used to fly the kites should be measured and marked in intervals of 5 yard. A color code may be the best way to mark the string (red = 5 and 10, blue = 15 and 20, etc.)

Method #1: Using an Astrolabe to Measure the Angle of the String

Students build an astrolabe using a plastic protractor, a straw, a string, and a metal weight. An astrolabe is an instrument used to measure how many degrees a celestial object is above the horizon. The measuring of the angle must be done when the kite is flying with a known amount of string (40 or 50 yards may be best). The group whose kite flies at the greatest angle will have the highest flying kite. This is a good activity to review with students the number of degrees in a circle and in a right angle. If there is not time for the students to build an astrolabe, then a "teacher's protractor" (large wooden protractor) may be used.

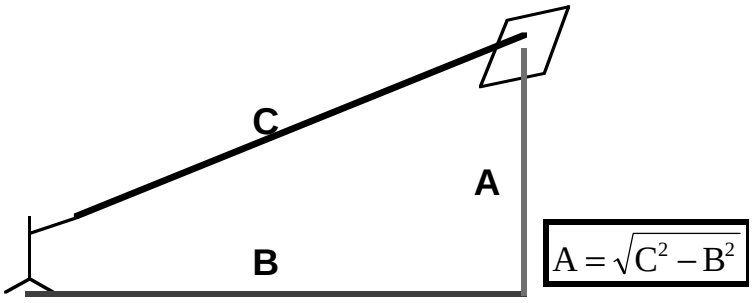


Method #2:Pythagorean Theorem

Students can calculate how high a kite flies by using the Pythagorean Theorem. Have one student flying the kite while another student stands directly below the flying kite. The string attached to the kite represents the hypotenuse of the triangle (C), and the distance between the student flying the kite and the student standing below the kite represents the base of the right triangle (A); therefore,the third side of the triangle (B) represents the height of the kite above the ground, and can be calculated using the equation:

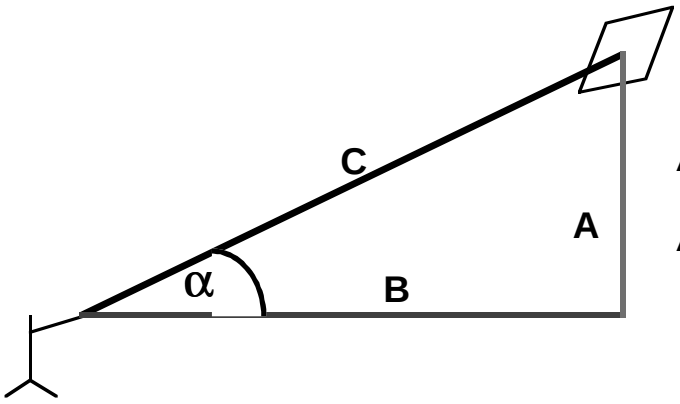
$$B^2 = C^2 - A^2$$

If the kites are flown on a football field, then the distance of A, between the student holding the string and the student standing below the kite, can be easily measured.



Method #3:Sine and Tangent Function

Using an astrolabe or a teacher's protractor, students measure the angle of the string that is attached to the flying kite. The students then record the amount of string that is let out to fly the kite by using the measurement marks on the string. The height that the kite is flying can then be determined by using the sine function since one angle of the triangle is known and the length of one side of the triangle (the hypotenuse) is known. The tangent function could be used in place of the sine function if the distance from the student flying the kite to the student standing under the kite is known . If students do not have calculators with the trig functions, then a table of sine and tangent values can be used.



A = tangent (α) **x B**

A = sine (α) **x C**

2. What Makes a Kite (and an Airplane) Fly ?

Using Internet websites, students will research Bernoulli's Principle in regard to how the curved surface shape of a kite (and an airplane wing) creates areas of high and low pressure, which in turn makes the kite (and a plane) fly.

3. Research and Development Project

Students will construct a new kite that will be based on the information and the practical experience gained from building and flying the first kite. The objective of this activity is to have the students modify the three kite designs (Diamond, Shied, and Hexagon) from the initial lesson with ideas of their own on what would make a kite fly higher. This extension allows students to use their ingenuity and imagination to draw, construct, and test an original kite design.

Rubric for Days 3 and 4

4 **Full Accomplishment**
Neat Kite
Ease - without help
Accurate measurements
Task-Oriented

3 **Substantial Accomplishment**
Neat Kite
Ease - Needed some help!
Accurate measurements
Task-Oriented

2 **Partial Accomplishment**
Neat Kite
Ease - Needed Help!
Accurate measurement - Appropriate size - minor measurement errors
Task-Oriented

1 **Little Accomplishment**
Neat Kite - Poorly constructed
Ease - Needed help
Accurate measurements - Size not appropriate - major measurement errors
Task-Oriented - Not serious